User Guide

Data Collection in Running Water
(Rivers, Open Sewage Canals & Nallahs)

Data taken from running bodies of water is considered a snapshot of current conditions. Conditions in these bodies of water often vary as water continues to flow through them.

Flow and Stream Hydrology

This is the most important aspect to understand in a flowing body of water. There are three basic elements to survey:

1. Length – determining upstream and downstream boundaries is important to limit the "control volume" which will be defined for monitoring.
2. Flow and tributaries – estimating flow, flow variations and tributary contributions (or draws).
3. Main sources of contamination – which can typically be classified as one of three: human, industrial or agronomy run-off.

Length

Satellite imaging and field survey are the best ways to map the area. Make sure you record detailed measurements and use a clear labeling to identify future monitoring points (colored spray paint cans are recommended). A minimum of three locations should be identified per kilometer of canal. Any point with a joining tributary needs to be identified.

Flow

The easiest way to measure flow in running water is to determine flow velocity and area of flow. The time taken by a ball to travel a specific distance helps us to estimate a mean flow velocity. An estimate cross section is needed to calculate the volumetric flow.

Flow Measurement Procedure

Materials:

- Plastic Balls of different colors
- Measuring tape
- Stop watch

1. Select two points within the canal length and consider the points as A and B. The distance between the two points can be anywhere between 20-50m. Ideally the canal will have an even cross section, steady central velocity and a straight flow path.
2. Select a starting "throw spot" at least 10 m upstream of point A. Throw three of the colored balls and record the time taken for each to travel from A to B.
3. Estimate cross section area by assuming an adequate geometric cross section (semicircular, rectangular or trapezoidal).
4. Use the provided excel sheet to calculate the flow in MLD (multiplying the cross section in m^2 by the velocity in m/s will yield a flow in m^3/s).

5. Please make sure to note the time of day when the experiment has been conducted. Canals in urban areas tend to exhibit "valley like" flow variations. Morning and evening are peak flow times while noon can be considered low flow.

The following measurements are required for calculating the flow.

- Average width of the canal
- Average water depth in the canal
- Distance traveled by ball
- Time taken to travel the distance

Retention Time

Hydraulic retention time is another important parameter required to decide dosing concentration of BiOWiSH™ in canals. The ball experiment (described above) can be used to calculate velocities at several instances. Divide the entire canal length in representative sections. Tributaries and flow variations must be taken into account to select the number and individual lengths for each of these sections.

Suppose you select four sections in a canal whose total length is 5 km as follows:

1. Section 1 (A to B) – 1.5km
2. Section 2 (B to C) – 400m
3. Section 3 (C to D) – 1.2km
4. Section 4 (D to E) – 1.9km

Step 1: Measure average surface velocities for each section.

Step 2: Use this velocity to calculate each section's HRT (ti) using the general formula:

(Time = Section length / Velocity)

Step 3: Calculate the retention time by adding t1 + t2 + t3 + t4.

Sources of Contamination

Survey and local contacts are the best methods to pinpoint the different sources of pollution entering the canal or river.

Sampling

After the flow variations (daily and seasonal) have been established, an appropriate sampling schedule can be established.

Recommended Protocol for Sampling in Open Sewage Canals and Nallahs

1. Choose at least 5 points per km of canal length. Label 1 L sample bottles accordingly.
2. At each point, prepare a composite sample by taking 500 ml grab samples every 10 minutes in a bucket. Ensure the sample does not contain any floating floc from the water surface or sludge.
3. Hence, for each point you should have 3.5L of sample in a bucket. Mix the sample in the bucket thoroughly and draw 1L of sample. Discard the remaining water and store the sample in a cooler with ice.

Example

Suppose we select 3 points (P1, P2 and P3) within 1 km of canal length:

Day 1: sample collection at 9.00 AM from point P1

1. Collect the first sample (500ml) in a bucket at 9.00am from point P1.
2. At 9.05am, collect another 500ml sample from the same point
3. Repeat the above exercise for 30 mins (till 9.30am)
4. By the end of exercise, you should have 3.5L of sample in the bucket.
5. Mix the sample in the bucket thoroughly and draw 1L of sample. Label this sample as "P1 @9AM date" and store in a cooler with ice.

Day 1: sample collection at 2.00PM from point P2

Repeat the sample collection steps 1 through 5 described above.

Day 1: sample collection at 7.00PM from point P3

Repeat the sample collection steps 1 through 5 described above.

Day 2: sample collection at 9:00AM from point P3

Day 2: sample collection at 2:00PM from point P2

Day 2: sample collection at 7:00PM from point P1

Note:

1. Please make sure to record temperature and pH of all samples before shipping to laboratory for testing.
2. Bottom conditions need to be recorded. Canals with thick layers of organic sludge will be susceptible to irregular COD swings during the first few weeks of the remediation program.

The following table can be used to compile data generated during 2 days:

Sample	P1		P2		P3	
Parameter	Day 1 9:00AM	Day 2 7:00PM	Day 1 2:00PM	Day 2 2:00PM	Day 1 7:00 PM	Day 2 9:00 AM
COD (mg/l)						
BOD (mg/l)						
TSS (mg/l)						
FOG (mg/l)						
TDS (mg/l)						
pH						
Temperature (°C)						
DO (mg/l)						

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